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WENDEROTH, LIND & PONACK L.L.P.
2033 K. STREET, NW
SUITE 800
WASHINGTON, DC 20006

EXAMINER	
NGUYEN, LEON VIET Q	

ART UNIT	PAPER NUMBER
2611	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/573,044	SHIRAKATA ET AL.
	Examiner	**Art Unit**
	LEON-VIET Q. NGUYEN	2611

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 March 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 March 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *3/22/06*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on 3/22/06 was filed after the mailing date of 3/22/06. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1, 2, 5, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma et al (US20030072255) in view of the background of applicant's specification (hereby referred to as the background).

Re claim 1, Ma teaches a data transmission method for a transmission apparatus of transmitting a plurality of data sequences from a plurality of transmission antennas to

a plurality of reception antennas using MIMO-OFDM (¶0017), the method comprising the steps of:

dividing a synchronization symbol (¶0017, ¶0090. The header symbol is interpreted to be a synchronization symbol) in which predetermined amplitudes and phases are assigned to a plurality of subcarriers (it is well known in that OFDM symbols have a phase and amplitude) which are spaced at predetermined frequency intervals (fig. 1B) and are orthogonal to each other (it is well known that OFDM symbols are orthogonal), into the plurality of transmission antennas (¶0017-¶0018), to generate a plurality of synchronization subsymbols (¶0017-¶0018).

Ma fails to teach converting the plurality of synchronization subsymbols into radio signals, and simultaneously transmitting the radio signals from the plurality of transmission antennas. However the background teaches converting a plurality of synchronization symbols (Ssync of transfer frames 1 and 2 in fig. 19) into radio signals (¶0008), and simultaneously transmitting the radio signals from the plurality of transmission antennas (TX1 and TX2 in fig. 18, ¶0008).

Therefore taking the combined teachings of Ma and the background as a whole, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the step of the background into the method of Ma. The motivation to combine Ma and the background would be to provide a robust system that improves efficiency (¶0004 of the background).

Re claim 2, the modified invention of Ma teaches a data transmission method further comprising:

modulating a plurality of pieces of transmission data to be transmitted from the plurality of transmission antennas into a plurality of data symbol sequences (modulating sections 902 and 903 in fig. 18 of the background, ¶0006 of the background); and

generating propagation coefficient estimation symbols (element 901 in fig. 18 of the background, ¶0006 of the background) orthogonal between each of the transmission antennas as symbols (¶0007 of the background) for estimating inverse functions of propagation coefficients possessed by a plurality of transfer path between the transmission antennas and the reception antennas (¶0011 of the background),

wherein the converting and transmitting step includes:

multiplexing (multiplexers 904 and 905 in fig. 18 of the background) the data symbol sequence, the synchronization subsymbol, and the propagation coefficient estimation symbol into a transfer frame for each of the plurality of transmission antennas (¶0007 of the background); and

converting the transfer frame multiplexed for each of the plurality of transmission antennas into a radio signal (¶0008 of the background).

Re claim 5, the modified invention of the background teaches a data transmission method wherein, in the converting and transmitting step, in order to

achieve synchronization between the plurality of transmission antennas, a single transmission local oscillator common (oscillator 908 in fig. 18 of the background) to the transmission antennas or a plurality of transmission local different among the transmission antennas, are used (¶0008 of the background).

Re claim 15, the claimed limitations recited have been analyzed and rejected with respect to claim 1. It would be obvious to have an apparatus to perform the method as claimed in claim 1.

3. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over background of applicant's specification (hereby referred to as the background) and Ma et al (US20030072255) in view of Dubuc et al (US20070263667).

Re claim 3, the modified invention of Ma teaches a data transmission method wherein the step of modulating into the data symbol sequence includes:

generating a data carrier (data symbol sequence 1 in fig. 19 of the background, it is well known that OFDM symbols are modulated onto subcarriers);

generating a pilot carrier (Ssync in fig. 19 of the background, it is well known in the art that pilot symbols are also known as synchronization and training symbols. Furthermore, it is well known that the symbols are modulated onto subcarriers); and

orthogonally multiplexing the data carrier and the pilot carrier (multiplexer 904 in fig. 18 of the background) into a plurality of data symbols (fig. 19 of the background), and outputting the plurality of orthogonally multiplexed data symbols as the data symbol sequence (fig. 19 of the background, ¶0007 of the background).

The modified invention of Ma fails to teach applying an amplitude and a phase based on the transmission data to a predetermined one of the plurality of subcarriers to generate the data carrier and assigning a known phase and amplitude to a subcarrier other than the data carrier to generate the pilot carrier. However Dubuc teaches applying an amplitude and a phase based on the transmission data to a predetermined one of the plurality of subcarriers to generate the data carrier (¶0060, the complex signal, whish is an OFDM signal, has an ampltiude and phase. It would be necessary to apply the amplitude and phase. Furthermore it is well known that OFDM signals are divided into subcarriers) and assigning a known phase and amplitude to a subcarrier other than the data carrier to generate the pilot carrier (¶0060, the pilot carrier is assigned a specific amplitude and phase).

Therefore taking the modified teachings of Ma and the background with Dubuc as a whole, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the step of Dubuc into the method of Ma and the background. The motivation to combine Dubuc, Ma and the background would be to correct for distortion (¶0064 of Dubuc).

Re claim 4, the modified invention of Ma teaches a data transmission method wherein, in the step of generating the pilot carrier, a known phase and amplitude are assigned as the pilot carrier to only one of data symbols to be simultaneously transmitted from the plurality of transmission antennas (¶0078 of Dubuc. A first pilot carrier has a first predetermined carrier amplitude and phase which is non-zero), and an amplitude of 0 is assigned as the pilot carrier to the other data symbols (¶0078 of Dubuc. A second pilot carrier has a second predetermined carrier amplitude and phase which is zero) to be simultaneously transmitted (¶0008 of the background).

4. Claim 6-8, 10, 11, 13, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over background of applicant's specification (hereby referred to as the background) in view of Ma et al (US20030072255).

Re claim 6, the background teaches a data reception method for a reception apparatus of receiving a plurality of data sequences transmitted from a plurality of transmission antennas using MIMO-OFDM (¶0004), via a plurality of reception antennas, wherein

the plurality of data sequences (transfer frames 1 and 2 in fig. 19) include synchronization symbols (Ssync in fig. 19) composed of a plurality of subcarriers orthogonal to each other (¶0008, the signals are orthogonally modulated) into the plurality of transmission antennas (TX1 and TX2 in fig. 18),

the method comprising the steps of:

receiving the plurality of data sequences for each of the reception antennas (RX1 and RX2 in fig. 18, ¶0009);

synchronizing and demodulating the data sequences (demodulators 910 and 911 in fig. 18, ¶0010) received by the plurality of reception antennas for each of the reception antennas (RX1 and RX2 in fig. 18); and

estimating characteristics (elements 912 and 913 in fig. 18) possessed by a plurality of transfer paths between the transmission antennas and the reception antennas (fig. 18), for each of the transfer paths, based on the received signal demodulated for each of the reception antennas and the synchronization symbol included in the received signal (¶0010).

The background fails to teach wherein the synchronization subsymbols is generated by dividing a synchronization symbol. However Ma teaches dividing a synchronization symbol into subsymbols (¶0017, ¶0090. The header symbol is interpreted to be a synchronization symbol).

Therefore taking the combined teachings of the background and Ma as a whole, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the step of Ma into the method of the background. The motivation to combine Ma and the background would be to provide fast and accurate initial synchronization (¶0023 of Ma).

Re claim 7, the modified invention of the background teaches a data reception method wherein the step of estimating the characteristics for each of the transfer paths includes estimating a frequency error occurring in each of the transfer paths (frequency error estimating sections 912 and 913 in fig. 18 of the background) from a correlation between the received signal demodulated for each of the reception antennas and the synchronization subsymbol included in the received signal (¶0010 of the background), and

the data reception method further includes, after the step of estimating the characteristics for each of the transfer paths, correcting a frequency of the received signal based on the estimated frequency error (frequency correcting section 915 and 916 in fig. 18 of the background, ¶0011 of the background).

Re claim 8, the modified invention of the background teaches a data reception method wherein the step of correcting the frequency of the received signal includes: calculating a frequency correction value for correcting the received signal (frequency correcting sections 915 and 916 in fig. 18 of the background), for each of the reception antennas, by weighted-averaging the estimated frequency error occurring in each of the transfer paths (averaging section 914 in fig. 18 of the background, ¶0011 of the background); and

correcting the frequency of the received signal based on the calculated frequency correction value for each of the reception antennas (¶0011 of the background), and

outputting the received signal having the corrected frequency (¶0011 of the background, R1 and R2).

Re claim 10, the modified invention of the background teaches a data reception method wherein the received signal includes propagation coefficient estimation symbols orthogonal to each other between each of the transmission antennas (Sref in fig. 19 of the background) as symbols for estimating inverse functions (element 917 in fig. 18 of the background) of propagation coefficients possessed by the plurality of transfer paths between the transmission antennas and the reception antennas (¶0011 of the background), and

the data reception method further includes, after the step of correcting the frequency of the received signal (frequency correcting sections 915 and 916 in fig. 18 of the background), estimating the inverse function of the propagation coefficient for each of the plurality of transfer paths (element 917 in fig. 18 of the background) based on the propagation coefficient estimation symbol included in the received signal (¶0011 of the background) having the corrected frequency (¶0011 of the background, R1 an R2), and based on the estimated inverse function, separating signals transmitted from the plurality of transmission antennas from the plurality of received signals (¶0011 of the background, T1 and T2).

Re claim 11, the modified invention of the background teaches a data reception method further comprising, between the synchronizing and demodulating step (demodulators 910 and 911 in fig. 18 of the background, ¶0010 of the background) and the step of calculating the characteristics for each of the transfer paths (demodulators 918 and 919 in fig. 18 of the background),

estimating a frequency error included in the demodulated received signal for each of the reception antennas (elements 912 and 913 in fig. 18 of the background, ¶0010 of the background), based on a correlation between the received signal demodulated by the synchronizing and demodulating step for each of the reception antennas (elements 912 and 913 in fig. 18 of the background perform correlation), and the synchronization symbol synthesized from the synchronization subsymbol included in the received signal (the transfer frames in fig. 19 of the background include the synchronization symbols);

calculating an average frequency error with respect to the plurality of received signals by weighted-averaging the estimated frequency errors (averaging section 914 in fig. 18 of the background, ¶0010 of the background); and

a second correcting step of correcting the frequencies of the plurality of received signals based on the calculated average frequency correction value (frequency correcting sections 915 and 916 in fig. 18 of the background, ¶0011 of the background).

Re claim 13, the modified invention of the background teaches a data reception method wherein, in the synchronizing and demodulating step (demodulators 910 and 911 in fig. 18 of the background), in order to achieve synchronization between the plurality of reception antennas, a single reception local oscillator common to the reception antennas or a plurality of reception local different among the reception antennas (oscillator 909 in fig. 18 of the background), is used.

Re claim 16, the claimed limitations recited have been analyzed and rejected with respect to claim 6. It would be obvious to have an apparatus to perform the method as claimed in claim 6.

5. Claim 9 rejected under 35 U.S.C. 103(a) as being unpatentable over background of applicant's specification (hereby referred to as the background) and Ma et al (US20030072255) in view of Funamoto et al (US20050147186).

Re claim 9, the modified invention of the background fails to teach a data reception method wherein, in the step of estimating the frequency error, a received symbol timing is generated based on a weighted average of peak timings of correlation values between the received signal and the synchronization subsymbol included in the received signal.

However Funamoto teaches in the step of estimating the frequency error (¶0208, clock-frequency error calculation), a received symbol timing (¶0208, time change rate) is

generated based on a weighted average of peak timings (¶0208, averages the changes of the peak timings). It would be obvious to take the peak timings from the output of correlators 912 and 913 in fig. 18 of the background).

Therefore taking the modified teachings of the background and Ma with Funamoto as a whole, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the step of Funamoto into the method of the background and Ma. The motivation to combine Funamoto, Ma and the background would be to cancel inter-symbol interference (¶0197 of Funamoto).

6. Claims 12 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over background of applicant's specification (hereby referred to as the background) and Ma et al (US20030072255) in view of Wilson et al (US7436757).

Re claim 12, the modified invention of the background fails to teach a data reception method wherein the receiving step includes:

receiving the signals transmitted from the plurality of transmission antennas using reception antennas the number of which is larger than the number of the plurality of data sequences;

determining reception levels of the signals received by the larger number of reception antennas; and

selecting or combining the signals received by the larger number of reception antennas, depending on the determined reception levels.

However Wilson teaches receiving the signals transmitted from the plurality of transmission antennas (antennas 11 and 12 in fig. 2) using reception antennas (antennas 21-24 in fig. 2) the number of which is larger than the number of the plurality of data sequences (it would be obvious to send two data sequences from the two transmit antennas);

determining reception levels of the signals received by the larger number of reception antennas (col. 7 lines 40-42, the SNIR is a measure of the signal strength); and

selecting or combining the signals received by the larger number of reception antennas (Rx beamformer in fig. 2), depending on the determined reception levels (it would be obvious utilize the signals with the highest SNIR).

Therefore taking the modified teachings of the background and Ma with Wilson as a whole, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the step of Wilson into the method of the background and Ma. The motivation to combine Wilson, Ma and the background would be to reduce the amount of noise and interference while maximizing the wanted signal energy (col. 6 lines 37-42 of Wilson).

Re claim 14, the modified invention of the background teaches a data reception method wherein the step of estimating the characteristics for each of the transfer paths

includes estimating rough frequency characteristics for each of the transfer paths (¶0010 of the background, the frequency error is interpreted to be a rough frequency characteristic), based on the synchronization subsymbol included in the received signal demodulated for each of the reception antennas (¶0010 of the background, based on the synchronization preamble Ssync), and the

method further comprises, after the step of estimating the characteristics for each of the transfer paths, estimating inverse functions of propagation coefficients possessed by the plurality of transfer paths based on the estimated rough frequency characteristics of each of the transfer paths (element 917 in fig. 18 of the background, ¶0011 of the background), and separating signals transmitted by the plurality of transmission antennas from the plurality of received signal based on the estimated inverse functions (¶0011 of the background, separates the multiplexed transmitted signals T1 and T2).

The modified invention of the background fails to teach wherein the frequency characteristics are estimated by interpolation of phases and amplitudes of the plurality of subcarriers included in the received signal. However Wilson teaches wherein a frequency characteristics (col. 2 lines 46-50, the channel estimate) is estimated by interpolation of phases and amplitudes of the plurality of subcarriers included in the received signal (fig. 1c, col. 2 lines 46-52. It would be obvious that the phase and the amplitude of the OFDM symbol be interpolated in time or frequency).

Therefore taking the modified teachings of the background and Ma with Wilson as a whole, it would have been obvious to one of ordinary skill in the art at the time the

invention was made to incorporate the step of Wilson into the method of the background and Ma. The motivation to combine Wilson, Ma and the background would be to improve channel estimation performance (col. 2 lines 53-57 of Wilson).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LEON-VIET Q. NGUYEN whose telephone number is (571)270-1185. The examiner can normally be reached on Monday-Friday, alternate Friday off, 7:30AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David C. Payne can be reached on 571-272-3024. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Leon-Viet Q Nguyen/
Examiner, Art Unit 2611

/David C. Payne/
Supervisory Patent Examiner, Art Unit 2611